BETTIS
Actuators & Controls
A Daniel Industries Company

Bettis Canada Ltd.
4112 91A Street
Edmonton, Alberta, Canada T6E 5V2
Tel: (780) 450-3600
Fax: (780) 450-1400

Edmonton

SERVICE MANUAL No. I-0210

PRESSUREMATIC SERIES SP

PRESSURE PILOT

CUSTOMER:______________________________

P.O.#:__________________________________

W.O.#:__________________________________

SET POINT :_____________________________

TAG:___________________________________

DATE:__________________________________

PRESSUREMATIC SERIES SP PRESSURE PILOT

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I INTRODUCTION

The Bettis Pressurematic Series SP Pilot is a high or low sensing, three way switching relay. In applications where line pressure needs to be monitored continuously, against a high or low set-point, the Series SP Pilot provides an effective method of switching signal pressure.

II SPECIFICATIONS

The Bettis Pressurematic Series SP Pilot is suitable for a range of set-point pressures from 30 to 5000 psig and temperatures between -50°F and 200°F. A maximum signal pressure of 1500 psig can be switched, with increasing pilot pressure or with decreasing pilot pressure. The signal Cv flow coefficient is 0.023. Standard or NACE material trims are available. It is designed to be installed in the vertical position.

Refer to applicable range table IB0211 or IB0212 on pages 4 and 5 for calibration data.

SP SERIES	PISTON DIAMETER (IN)	SPRING WIRE DIAMETER (IN)	SPRING RATE (LB/IN)	INSTRUMENT SIGNAL PRESSURE (PSIG)	RANGE SCREW TURNS MIN / MAX	N.O. INSTRUMENT SIGNAL (OFF WITH INCREASING PILOT PRESSURE) PILOT SET POINT (PSIG)	PILOT RESET POINT (PSIG)	PILOT DEAD BAND (PSIG)	N.C. INSTRUMENT SIGNAL (ON WITH INCREASING PILOT PRESSURE) PILOT SET POINT (PSIG)	PILOT RESET POINT (PSIG)	PILOT DEAD BAND (PSIG)
SP-20LL	1.250	0.225	EXTRA LIGHT (83)	100	1	15	30	15	30	15	15
					18	100	130	30	130	100	30
				1500	1	10	30	20	30	10	20
					18	100	135	35	135	100	35
SP-20L	1.250	0.263	LIGHT (200)	100	1	40	60	20	60	40	20
					10	155	190	35	190	155	35
				1500	1	35	60	25	60	35	25
					10	155	195	40	195	155	40
△ SP-20M	1.250	0.312	MEDIUM (449)	100	1	70	90	20	90	70	20
					10	320	355	35	355	320	35
				1500	1	65	95	30	95	65	30
					10	315	360	45	360	315	45
SP-20H	1.250	0.331	HEAVY (631)	100	1	125	150	25	150	125	25
					10	490	530	40	530	490	40
				1500	1	120	155	35	155	120	35
					10	490	540	50	540	490	50
△ SP-10L	0.625	0.312	LIGHT (200)	100	1	175	210	35	210	175	35
					10	625	680	55	680	625	55
				1500	1	170	230	60	230	170	60
					10	600	680	80	680	600	80
SP-10M	0.625	0.312	MEDIUM (449)	100	1	340	385	45	385	340	45
					10	1355	1440	85	1440	1355	85
				1500	1	320	395	75	395	320	75
					10	1330	1450	120	1450	1330	120
SP-10H	0.625	0.331	HEAVY (631)	100	1	525	585	60	585	525	60
					10	1970	2130	160	2130	1970	160
				1500	1	505	595	90	595	505	90
					10	1930	2155	225	2155	1930	225
SP-06M	0.375	0.312	MEDIUM (449)	100	1	895	1070	175	1070	895	175
					10	3515	3860	345	3860	3515	345
				1500	1	865	1110	245	1110	865	245
					10	3465	3945	480	3945	3465	480
SP-06H	0.375	0.331	HEAVY (631)	100	1	1255	1505	250	1505	1255	250
					10	4560	5000	440	5000	4560	440
				1500	1	1215	1560	345	1560	1215	345
					10	4500	5000	500	5000	4500	500

NOTE:

1) THE RANGE SCREW TURNS ARE COUNTED FROM A ZERO REFERENCE POSITION WITH INSTRUMENT SIGNAL AND PILOT PRESSURES AT ZERO. THE ZERO REFERENCE POSITION OCCURS WHEN CONTACT IS FIRST MADE BETWEEN THE SPRING CAP AND SPRING, WITH THE PISTON FULLY DOWN.

△ 2) DATA BASED ON 0.25" PISTON TRAVEL AT ROOM TEMPERATURE, WITH PRECONDITIONED SPRING, USING AIR SIGNAL MEDIA.

3) ALLOW 10% DEVIATION FROM TABULATED VALUES DUE TO MANUFACTURING TOLERANCES AND TEMPERATURE AFFECTS.

4) PILOT SET-POINTS MAY BE INTERPOLATED LINEARLY, BETWEEN MINIMUM AND MAXIMUM RANGE SCREW TURNS, AS WELL AS BETWEEN 100 PSIG AND 1500 PSIG INSTRUMENT SIGNAL PRESSURES.

5) REFER TO DWG AP-1299 FOR PRESSUREMATIC SP PILOT MODEL DESIGNATIONS AND DWG APB1280 FOR ASSEMBLY DETAIL.

UPDT STD, UPDATE SP-20M
ADD SP-10L, ADD PNEUMATIC
△3 RB-1998-06-22 @ 08052-4-R
0.331 WAS 0.311
UPDATE SP-20L & SP-20LL VALUES
△2 RB-1997-12-15 @ 08052-4-R
UPDATE INSTRUMENT SIGNAL VALUES
△1 RB-1997-05-23 @ 08052-4-R
REV BY-DATE+REF

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RANGE TABLE, PNEUMATIC SIGNAL
FOR PRESSUREMATIC SP PILOT
SP-20, SP-10, SP-06

1-0211--.DVG_VIEW_00
JUN-22-98

SCALE N/A | BY ML | CHK [signature] | DATE APR-03-97
V.O. 8052-4-R | DWG. NO. 1B0211 | REV 3-

DWG. NO. 1B0211

SP SERIES	PISTON DIAMETER (IN)	SPRING WIRE DIAMETER (IN)	SPRING RATE (LB/IN)	INSTRUMENT SIGNAL PRESSURE (PSIG)	RANGE SCREW TURNS MIN/MAX	N.O. INSTRUMENT SIGNAL (OFF WITH INCREASING PILOT PRESSURE) PILOT SET POINT (PSIG)	N.O. PILOT RESET POINT (PSIG)	N.O. PILOT DEAD BAND (PSIG)	N.C. INSTRUMENT SIGNAL (ON WITH INCREASING PILOT PRESSURE) PILOT SET POINT (PSIG)	N.C. PILOT RESET POINT (PSIG)	N.C. PILOT DEAD BAND (PSIG)
SP-20L	1.250	0.263	LIGHT (200)	100	1	30	70	40	70	30	40
					10	140	210	70	210	140	70
				1500	1	20	70	50	70	20	50
					10	140	220	80	220	140	80
SP-20M	1.250	0.312	MEDIUM (449)	100	1	50	90	40	90	50	40
					10	300	370	70	370	300	70
				1500	1	45	105	60	105	45	60
					10	300	390	90	390	300	90
SP-20H	1.250	0.331	HEAVY (631)	100	1	100	150	50	150	100	50
					10	470	550	80	550	470	80
				1500	1	100	170	70	170	100	70
					10	500	600	100	600	500	100
SP-10M	0.625	0.312	MEDIUM (449)	100	1	230	330	100	330	230	100
					10	1240	1420	180	1420	1240	180
				1500	1	215	415	200	415	215	200
					10	1200	1500	300	1500	1200	300
SP-10H	0.625	0.331	HEAVY (631)	100	1	410	535	125	535	410	125 △
					10	1780	2110	330	2110	1780	330
				1500	1	360	610	250	610	360	250
					10	1650	2150	500	2150	1650	500
SP-06M-C	0.375	0.312	MEDIUM (449)	100	1	720	1040	320	1040	720	320
					10	3450	4080	630	4080	3450	630
				1500	1	650	990	340	990	650	340
					10	3370	4150	780	4150	3370	780
SP-06H-C	0.375	0.331	HEAVY (631)	100	1	1070	1520	450	1520	1070	450 △
					10	3920	4800	880	4800	3920	880
				1500	1	1150	1750	600	1750	1150	600
					10	3900	4800	900	4800	3900	900

NOTE:

1) THE RANGE SCREW TURNS ARE COUNTED FROM A ZERO REFERENCE POSITION WITH INSTRUMENT SIGNAL AND PILOT PRESSURES AT ZERO. THE ZERO REFERENCE POSITION OCCURS WHEN CONTACT IS FIRST MADE BETWEEN THE SPRING CAP AND SPRING, WITH THE PISTON FULLY DOWN.

2) DATA BASED ON 0.25" PISTON TRAVEL AT ROOM TEMPERATURE, WITH PRECONDITIONED SPRING, USING UNIVIS J13 HYDRAULIC FLUID SIGNAL MEDIA.

3) ALLOW 10% DEVIATION FROM TABULATED VALUES DUE TO MANUFACTURING TOLERANCES AND TEMPERATURE AFFECTS.

4) PILOT SET-POINTS MAY BE INTERPOLATED LINEARLY, BETWEEN MINIMUM AND MAXIMUM RANGE SCREW TURNS, AS WELL AS BETWEEN 100 PSIG AND 1500 PSIG INSTRUMENT SIGNAL PRESSURES.

5) REFER TO DWG AP-1299 FOR PRESSUREMATIC SP PILOT MODEL DESIGNATIONS AND DWG APB1280 FOR ASSEMBLY DETAIL.

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RANGE TABLE, UNIVIS J13 HYDRAULIC SIGNAL FOR PRESSUREMATIC SP PILOT SP-20, SP-10, SP-06

CORRECTION △ RB-1998-07-23 @ 08052-1-R	I-0212--.DWG_VIEW_00 JUL-23-98
REV BY-DATE-REF	SCALE N/A · BY ML · CHK [illegible] · DATE JUN-22-98
	V.O. 08052-4-R · DWG NO. IB0212 · REV 1-

DWG. NO. IB0212

III ASSEMBLY

Refer to the typical assembly drawing on page 8.

A. SPOOL ASSEMBLY

1. Visually inspect the valve spool (4) for damage, checking along its entire length. Scratches, nicks and dents on the surface of the spool may result in leakage or operational failure. Clean the valve spool (4).

   NOTE: Damaged spools should be replaced.

2. Visually inspect the four 1/32 diameter cross drilled signal ports, checking that the openings have been deburred with a smooth radius.

   NOTE: Sharp edges on any of the signal port openings may result in damage to the spool o-ring (18) as the Series SP Pilot switches, resulting in leakage and operational failure.

3. Install the Lee plug dry (14) by pressing or driving it into the non-threaded end of the valve spool (4) until the exposed end of the pin is flush with the exposed end of the plug.

   NOTE: Take precautions to protect the spool surfaces during Lee plug installation.

4. Install the jam nut (15), with Loctite Threadlocker 290, or equivalent, applied to the spool valve (4) threads, hand tight only.

B. BODY ASSEMBLY

1. Visually inspect the body (10), adapter (12) and piston (11), checking for damage to sealing areas, burrs and debris. Remove any burrs and debris. Clean all parts.

   NOTE: Damage to any sealing area will result in leakage. Damaged parts should be replaced.

2. Lubricate the piston o-ring (22), and back-up (24) (used for 3/8 diameter piston only) with petroleum jelly and install onto the piston (11).

3. Lubricate the adapter o-ring (23) with petroleum jelly and install onto the adapter (12).

4. Install the piston completely into the body (10), using hand force only, with the tapped end facing out.

NOTE: The 3/8 diameter piston is tapped with a 4-UNC hole, and the 5/8 and 1-1/4 pistons are tapped with a 1/4NC hole, to facilitate removal of the piston, as required.

5. Generously lubricate the body (10) threads and the adapter (12) threads with petroleum jelly. Thread the adapter (12) into the body (10) and torque to 100 ft-lb.

6. Generously lubricate the top end of the body (10) coating the piston (11) with petroleum jelly.

C. 3-WAY VALVE ASSEMBLY

1. Visually inspect the two end bodies (1), two spool bushings (3), and centre body (2), checking for damage to sealing areas, burrs and debris. Remove all burrs and debris. Clean all parts.

   NOTE: Damage to any sealing area may result in leakage. Damaged parts should be replaced.

2. Stamp the two end body ports (1) and the centre body port as per the typical assembly drawing on page 8.

3. Lubricate with petroleum jelly and install the two bushing o-rings (20) into the two end bodies (1).

   NOTE: Ensure that the two bushing o-rings are installed correctly into their grooves, before the spool bushings are threaded in place, or o-ring damage and leakage may result.

4. Lubricate the two spool bushings (3) with petroleum jelly and thread into the end bodies. Torque the two spool bushings to 20 ft-lb.

5. Lay the assembled lower end body (1) down on a clean surface with the spool bushing (3) facing down.

6. Lubricate with petroleum jelly and install one end body o-ring (21) onto its groove in the lower end body (1) from step 4.

7. Lubricate with petroleum jelly and install the urethane spool o-ring (18) and the centre body o-ring (19) into their applicable grooves in the centre body.

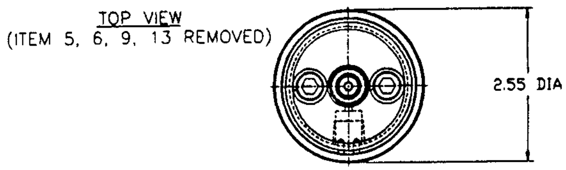
8. Place the assembled centre body (2) onto the lower end body (1) from step 4, with the two 1/4 NPT ports aligned.

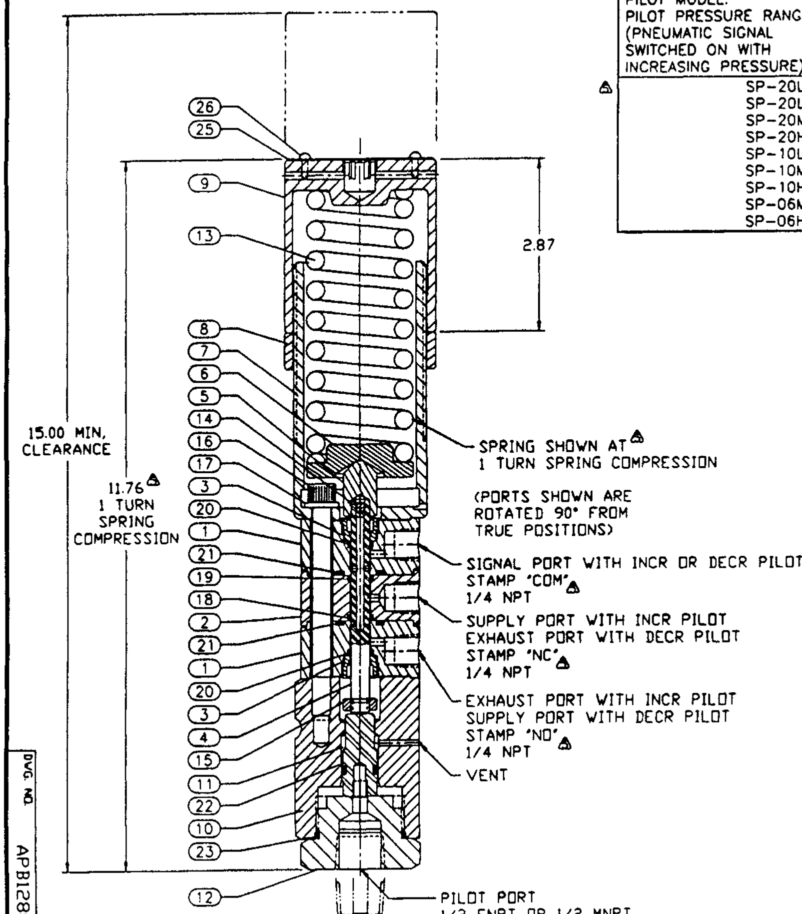
   NOTE: Ensure that the urethane spool o-ring (18) is placed against the lower end body.

9. Lubricate with petroleum jelly and install the second end body o-ring (21) onto its groove, in the upper end body (1).

10. Place the upper end body (1) onto the assembly from step 7. With the three 1/4 NPT ports aligned, clamp lightly together in a vice which is equipped with soft jaws.

   NOTE: Ensure that all of the o-rings are installed correctly into their grooves, as the bodies are being assembled together, or o-ring damage and leakage may result.





SPECIFICATIONS:				
PORTS:	PILOT	1/2 FNPT OR 1/2 MNPT		
	SIGNAL	1/4 FNPT		
MEDIA:	PILOT	CRUDE OIL, GAS		
	SIGNAL	AIR, GAS, HYD. FLUID (SEE NOTE 4)		
MAX. WORKING PRESSURE:	PILOT	5000 PSI (340 BARg)		
	SIGNAL	1500 PSI (102 BARg)		
TEMPERATURE RATING:		-50°F TO +200°F (-46°C TO +93°C)		
FLOW COEFFICIENT (Cv):		0.023		
SET POINT DRIFT:		3%		
PILOT MODEL: PILOT PRESSURE RANGE (PNEUMATIC SIGNAL SWITCHED ON WITH INCREASING PRESSURE)		PILOT PRESSURE RANGE (PSI)	MAXIMUM PNEUMATIC DEADBAND (PSI)	PISTON DIAMETER (INCHES)
	SP-20LL	40 - 130	35	1.250
	SP-20L	70 - 180	40	1.250
	SP-20M	100 - 300	45	1.250
	SP-20H	150 - 500	50	1.250
	SP-10L	200 - 600	80	0.625
	SP-10M	400 - 1300	120	0.625
	SP-10H	600 - 2100	225	0.625
	SP-06M	1200 - 3500	480	0.375
	SP-06H	1600 - 5000	500	0.375

ITEM	PART NO.	DESCRIPTION	MATERIAL	QTY	NOTE
1	916-010	END BODY	AL 6061-T6 ANDZ	2	
2	916-020	CENTER BODY	AL 6061-T6 ANDZ	1	
3	916-030	SPOOL BUSHING	AL 7075-T651	2	
4	916-040	VALVE SPOOL	SS 304	1	
5	916-050	SPOOL CAP	AL 7075-T651	1	
6	916-061	SPRING SEAT, MEDIUM	SS 303	1	
7	916-070	SPRING HOUSING	AL 6061-T6 ANDZ	1	
8	916-080	LOCKNUT	AL 6061-T6 ANDZ	1	
9	916-090	SPRING CAP	AL 6061-T6 ANDZ	1	
10	916-100	BODY	AL 6061-T6 ANDZ	1	
11	916-110	PISTON, 0.625 DIA	17-4 PH	1	
12	916-120	ADAPTOR, 1/2 MNPT	AL 6061-T6 ANDZ	1	
13	916-132	SPRING, MEDIUM	SS 302	1	
14	916-170	LEE PLUG, SPOOL	AL 2024-T4 ANDZ	1	
15	650-282	JAM NUT, SPOOL	HEXJ SS 304	1	
16	650-259	CAPSCREW, SPRING HOUSING	HXSC SS 304	2	
17	650-284	LOCKWASHER, SPRING HOUSING	HLCK SS 304	2	
18	916-190	O-RING, SPOOL	URETHANE 90A	1	(Y)
19	620-011	O-RING, CENTER BODY	NITRILE 70A MOS2	1	(Y)
20	620-011	O-RING, END BODY	NITRILE 70A MOS2	2	(Y)
21	620-114	O-RING, END BODY	NITRILE 70A	2	(Y)
22	620-111	O-RING, PISTON	NITRILE 70A	1	(Y)
23	620-125	O-RING, ADAPTOR	NITRILE 70A	1	(Y)
24	623-106	BACKUP RING, PISTON (NOTE 2)	NITRILE 70A	1	(Y)
25	916-001	NAMEPLATE	AL 3003-H14	1	
26	700-099	DRIVE SCREW	SS 304	3	

NOTE:
1. (Y) RECOMMENDED SPARE PARTS/REPAIR KIT.
2. 0.375 DIAMETER PISTON O-RING USES A BACKUP RING (24) NOT SHOWN.
3. MAXIMUM DEADBANDS VALUES LISTED ARE FOR MAXIMUM PILOT AND PNEUMATIC SIGNAL PRESSURE, AT ROOM TEMPERATURE. ALLOW 10% DEVIATION DUE TO MANUFACTURING TOLERANCES AND TEMPERATURE AFFECTS. REFER TO RANGE TABLE IB0211.
4. FOR UNIVIS J13 HYDRAULIC SIGNAL REFER TO RANGE TABLE IB0212.
5. STAMP ALL CHARACTERS 0.12 [3 mm] HEIGHT.
6. PART NUMBERS LISTED ARE FOR PRESSUREMATIC MODEL SP-10M.

UNLESS SPECIFIED OTHERWISE ALL DIMENSIONS INCHES (mm)

11.76 WAS 12.64 MAX
+BOSS TO BODY (10), + NOTE 4
UPDT TB. STAMPING & RANGE VALUE
RB-1998-06-23 @ 08052-4-R
UPDATE PILOT PRESURE RANGE
RB-1997-05-23@08052-4-R
GENERAL UPDATE
DY-1997-04-03@08052-4-R
REV BY-DATE+REF

TOLERANCES
XXX ±0.5 [±10]
XX ±0.2 [±5]
X ±0.1 [±2]

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PRESSUREMATIC SERIES SP PRESSURE PILOT, TYPICAL ASSEMBLY AND SPECIFICATIONS, NC OR NO INSTRUMENT SIGNAL PILOT PRESSURE, STANDARD TRIM

AP1280--.DWG JUN-23-98 | WEIGHT 6.0 LB
SCALE 1:2 | BY DY | CHK | DATE SEP-19-96
V.O. 08052-4-R | DWG. NO. APB1280 | REV 5-

DWG. NO. APB1280

11. Lubricate the spool assembly from Section A with petroleum jelly. Install the spool assembly, using hand force only, into the assembly from step 9, through the lower end body (1) first. The jam nut (15) will then be positioned between the piston (11) and the end body (1).

12. Remove the assembly, from step 10, from the vice.

D. SPRING HOUSING ASSEMBLY

1. Visually inspect the spring housing (7), spool cap (5), spring seat (6), locknut (8), spring (13) and spring cap (9), checking for burrs and debris. Remove all burrs and debris. Clean all parts.

2. Put the body assembly from Section B into a vice equipped with soft jaws with the adapter facing down, and clamp lightly in place.

3. Place the assembly from Section C onto the body assembly, with the two 3/8 diameter clearance holes and three 1/4 NPT ports aligned, and the jam nut (15) end against the piston (11). Check that the spring housing (7) vent is aligned with the body (10) vent, for field installation purposes.

4. Place the spool cap (5) over the exposed non-threaded end of the valve spool (4).

5. Position the spring housing (7) over the end body (1) aligning the two 3/8 diameter clearance holes.

6. Lubricate with petroleum jelly and install the two socket capscrews (16) and lockwashers (17) so that they are hand tight. Then gradually, and alternately, torque the two socket capscrews (16) to 10 ft-lb.

7. Place the spring seat (6) and spring (13) over the spool cap (5).

8. Thread the locknut (8), followed by the spring cap (9), onto the spring housing (7). Thread the spring cap (9) over the spring housing (7) until the spring (13) has been engaged and compressed a minimum of one full turn.

   NOTE: Following calibration, the locknut (8) is tightened by hand to maintain the set-point. The resulting torque is approximately 10 ft-lb.

IV TESTING AND CALIBRATION

Refer to the typical assembly drawing on page 8. The SP pilot piston and spool must be cycled 20 times in order to seat the o-ring seals, prior to testing and calibration.

A. PISTON LEAKAGE TEST

1. Apply 100 psig air to the 1/2 NPT pilot port connection and maintain for 1 minute.

2. Using soapy fluid, check for leakage at the vent port. No visible leakage is permitted.

B. VALVE SPOOL LEAKAGE TEST

1. Apply 100 psig air at the port stamped ‘NO’ on one end body (1) with the second end body(1) connection plugged, and maintain for 1 minute.

2. Using soapy fluid, check for leakage at the centre body (2) port, joints between body sections (1,2), and ends of body sections (1). No visible leakage is permitted.

C. PILOT CALIBRATION

1. Adjust the spring compression according to the calibration table on page 4 or 5. Interpolation may be used to estimate spring compression for intermediate set-points. If signal is hydraulic fluid, calibration should be done with hydraulic fluid.

2. Apply 100 psig supply pressure at the 1/4 NPT supply port connection, stamped “SUP”, via a closed isolation valve.

3. Apply required pilot pressure at the 1/2 NPT pilot port, on the adapter, via a pressure regulator and closed isolation valve.

4. Install an adequately rated pressure gauge at the 1/4 NPT signal port, stamped “SIG”.

5. Open the supply and pilot isolation valves.

    a) For signal "ON" with increasing pilot pressure, using the pressure regulator, gradually increase pilot pressure at a rate of 20 psi/minute until signal pressure switches on. Record the actual set-point pressure.

    b) For signal "ON" with decreasing pressure, using the pressure regulator, gradually decrease pilot pressure at a rate of 20 psi/minute until signal pressure switches on. Record the actual set-point pressure.

6. Adjust the spring compression as required and repeat step 5, until the required set-point is reached. Hand tighten the locknut (8) to maintain the set-point.

7. Stamp the nameplate (25) as required and mount on the spring cap (9).

    NOTE: This step is performed by the factory.

V DISASSEMBLY

Refer to the typical assembly drawing on page 8.

1. Release any trapped pressure to zero before proceeding.

2. Follow the directions in Section III in reverse.

VI INSTALLATION

Before installing the unit, observe the following:

1. Check for external physical damage.

2. Check that the nameplate has been stamped with Serial No., Model No., Set-Point and Tag No. (if applicable).

3. With the factory supplied mounting kit, mount the unit as required.

4. Layout and install the signal, supply, vent and pilot line tubing and fittings, as required.

5. Apply pressure to pilot and supply lines, as required.

VII MAINTENANCE

Refer to the typical assembly drawing on page 8. Regular maintenance should be performed annually, or as required.

1. Replace seals and other soft parts every five years or when leakage occurs. Spare parts kits are available from the factory, based on the Pressurematic model number.

2. If installing the spare parts kit does not correct the operational problem, call the factory for assistance.

3. Check the pilot set point and reset point pressures annually, or as required.

VIII TROUBLESHOOTING

1. Pilot does not switch at desired set point.

    a) Recalibrate the pilot.

    b) Check for pilot pressure leakage.

2. Signal pressure does not switch on.

    a) Check for supply and signal pressure leakage.

3. Supply pressure leaks to vent or signal lines, or to atmosphere.

    a) Check the condition of the internal spool and body o-rings.

4. Pilot pressure leaks to atmosphere.

    a) Check the condition of the internal piston and adapter o-rings.

IX PRESSUREMATIC SERIES SP PILOT NOTES